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Effects of Garlic Vinegar Supplementation on Changes of Body Weight, Plasma Glucose, and Plasma Lipid Profile in High Cholesterol-fed Rats

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Abstract

This study was carried out to investigate the effects of garlic vinegar supplementation on changes in body weight, blood glucose and serum triglyceride and cholesterol. Rats were fed a cholesterol-diet with or without garlic vinegar (20% garlic juice) supplement for 28 days. Body weights in rats fed a diet containing garlic vinegar were significantly lower than those of control rats. The concentration of plasma glucose, total cholesterol, LDL-cholesterol, and HDL-cholesterol were not significantly different between the two groups for a period of up to four weeks. However, the concentration of plasma triglyceride was slightly decreased in the garlic vinegar-supplemented group. Results suggest that the supplementation of garlic vinegar is beneficial for weight reduction in high-cholesterol fed rats.

Key words: garlic vinegar, body weight, plasma glucose, plasma lipids

INTRODUCTION

Allium sativum, or garlic, is a common food in most parts of the world. Garlic has long been used as a spice, and has been reported to possess medicinal and pharmacological properties. It has been used as a folk remedy for a variety of ailments since ancient times. In the past decade, there has been a renewed research interest in the therapeutic uses of garlic. Several studies have indicated that garlic is effective as a hypoglycemic (1), anticoagulative (2), antihypertensive (3), and/or hypolipidemic agent (4-6).

Atherosclerosis and coronary artery disease is a leading cause of death in the developed countries of the world. It is now recognized that hyperlipidemia is associated with increased incidence of premature ischemic heart disease. The growing interest in the potential antiatherosclerotic efficacy of garlic has been recently promoted by encouraging findings in two aspects: in lowering of blood lipids (7) and an enhancement of fibrinolytic processes (2). Its effect on lowering of fasting serum cholesterol values has been described not only in rabbits (7) but also in humans (8). Also an inhibition of an alimentary increase of cholesterol and triglyceride values was demonstrated after administration of garlic in both humans (9) and rats (10).

However, in most of the previous studies a single or short-term administration of an extremely high dose of garlic components has been used in the form of garlic oil, garlic clove, or garlic powder. The majority of these studies were carried out either with fresh garlic or with the oily extract of a considerable amount of fresh garlic (up to 50 g daily). Since the intake of these preparations are linked to the well-known and unpleasant smell of garlic, some have chosen the production of pills which contain dried garlic under a sugar coat by which means the garlic smell can be circumvented for therapeutic use. It is still controversial whether the efficacy of garlic is consistent. Intake of garlic pills, even in relatively high dosages, did not result in any beneficial effects on lipids values (11). Also the recent study reported that the capsules containing the oily extract of 50 g or 16 g of fresh garlic did not show any effect on human lipid levels and platelet aggregation. A reason for the lack of efficacy may be a deterioration or even complete loss of the active principle of garlic due to the drying process (11).

In Korea, intake of natural food vinegar has became popular, but there is no report on the nutritional effects of garlic vinegar administration at relatively low doses. Therefore, the primary purpose of this study was to determine whether garlic vinegar supplementation exhibits hypolipidemic response in rats fed a high-cholesterol diet. Also, this study investigated the influence of garlic vinegar supplementation on changes of blood glucose and body weight.

MATERIALS AND METHODS

Twenty (Sprague-Dawley) male rats were obtained from K.L.E.C (Korea Life Engineering Corporation, Seoul, Korea). The average body weight of the animals upon arrivals was 90±11 g. Animals were individually housed in stainless steel wire-bottom cages in a room maintained at 22~24°C and about 65% relative humidity. The room was exposed to alternating 12-hr periods of light and dark. Tap water was freely available. The experimental diets were supplemented with 1 g/100 g of cholesterol as shown in Table 1. One half of the animals received the experimental diet alone, while the others

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Table 1. Composition of the experimental diets (g/100 g of diet)

Ingredient	Control	Garlic vinegar[1)]
Corn starch	65.2	65.2
Casein	20	20
Corn oil	5.0	5.0
α-Cellulose	3.8	3.8
Min. mix	3.5	3.5
Vit. mix	1.0	1.0
Choline	0.2	0.2
DL-Methionine	0.3	0.3
Cholesterol	1	1
Garlic vinegar	0 ml	35 ml

[1)]Garlic vinegar fermented with a 20% fresh garlic juice

Table 2. Effects of garlic vinegar supplementation on body weight, food intakes, and FER[1)] in rats fed cholesterol

	Control	Garlic vinegar supplementation
Body weight at beginning (g)	141.21±8.66[2)]	142.00±6.41[NS3)]
Body weight at sacrifice (g)	301.95±15.35	283.18±8.47*
Food intake (g/day)	19.67±2.03	18.79±0.92[NS]
FER[1)]	0.293±0.02	0.269±0.01*

[1)]$FER = \frac{\text{weight gain for 4 wks}}{\text{food intake for 4 wks}}$

[2)]Mean±SD

[3)]Not significantly different at $p<0.05$ from control group.

*Significantly different at $p<0.05$ from control group.

received the same diet also containing garlic vinegar. The diet containing garlic was passed through a sieve to avoid lumping. The garlic vinegar contained 20% (v/v) fresh garlic juice.

At the end of the experimental period, rats were sacrificed by treating with light anethesia (ethyl ether) following a 16 hr fast. Blood samples were collected from the abdominal aorta, and the plasma was separated after centrifugation (3000 rpm, for 15 min) and stored at -20°C until assayed. Concentrations of plasma glucose, triglycerides, total-cholesterol, and high-density lipoprotein (HDL) cholesterol were analyzed enzymatically using commercial kits (Yeongdong Pharm. Corp, Seoul, Korea). Concentration of plasma low-density lipoprotein (LDL) cholesterol was calculated by the Friedwald method (12).

Statistical analysis

All data are presented as means and standard deviation. Statistical analyses were performed using Student's t-test. Differences were considered significant when p valne was less than 0.05.

RESULTS AND DISCUSSION

It has been reported that garlic possesses hypoglycemic and hypolipidemic properties and a protective effect against atherosclerosis. However, most investigators used large doses of garlic or garlic oil in a relatively short experimental period (13). There is no report on the nutritional effects of garlic vinegar administration at relatively low doses. In the present study, the nutritional effect of continuous intakes of garlic vinegar in daily use in a high-cholesterol fed rats was investigated.

Feed efficiency ratio and body weight

The mean food intake was not significantly different after 28 days of garlic vinegar supplementation (Table 2). However, body weight and feed efficiency ratio (FER) of the control and the garlic vinegar supplemented diets were significantly different. Body weight was significantly decreased in the group fed the vinegar-supplemented diets (301.9±15 g vs. 283.0±8 g). Rats fed a garlic vinegar diet had 6% lower body weight and 8% lower FER than did the animals fed a control diet (Table 2). The results of the present study are consistent with an earlier study (14) which reported that the mean values of body weight was significantly lowered after 28 days of garlic powder (2%) supplementation (261.6±1.6 g vs 250.3±4.1 g). The effect of weight reduction in rats was maintained when garlic powder was replaced by garlic vinegar as a garlic source.

Concentrations of plasma glucose, triglyceride, and cholesterol

The hypoglycemic properties of garlic were first discovered in 1933 (15). The hypoglycemic effect in alloxan-induced diabetes in rabbits were reported in 1983 (16). Also, Nagai et al. (17) showed that garlic feeding prevented the rise of blood glucose after glucose loading in a standard glucose tolerance test in rats. Recently, Chang and Johnson (1) suggested that garlic reduces lipid synthesis and influences glycogen metabolism in the liver of rats. Also they suggest that the hypoglycemic effect of garlic seems to be associated with an increase of insulin level. Augusti and Benaim (18) suggest that the hypoglycemic effect of allyl propyl disulfide is due to an insulin-sparing action mediated by inactivation of those compounds which antagonize insulin. However, in the present study, the concentration of plasma glucose was not significantly different between the two groups for a period of up to four weeks. Recent study have demonstrated that plasma total cholesterol was significantly decreased in 3% garlic supplementation group compared to control when they were fed 0.5% cholesterol supplemented diet ($p<0.05$) (19).

However, In the present study, there were no significant differences in plasma total cholesterol, LDL-cholesterol, and HDL-cholesterol concentrations (Table 3). The concentration of plasma triglyceride, however, tended to be lower in the group fed the garlic vinegar-supplemented diet by 30% (91.5±59 vs 65.6±25 mg/dl). The reason for no statistical difference may be due to the large variation of data. The plasma triglyceride concentration was significantly decreased by garlic powder supplementation for 28 days, whereas there were no significant differences in plasma total cholesterol or HDL-cholesterol concentrations (14). In the present study, the beneficial effects of garlic in rats seems to be maintained when garlic powder is replaced by a garlic vinegar as a garlic source. These effects suggest that garlic vinegar maybe of potential value in hypotriglyceridemic diets for hypertriglyceridemic individuals. It has been suggested that garlic supplementation enhances triglyceride catabolism and growth of inter-

Table 3. Effect of garlic vinegar supplementation in concentrations of plasma glucose, triglyceride and cholesterol in high cholesterol-fed rats

Variables	Control	Garlic vinegar
Glucose (mg/dl)	151.73±42.86[1)]	153.08±57.36[NS2)]
Triglyceride (mg/dl)	91.56±59.85	65.65±25.19[NS]
Total cholesterol (mg/dl)	98.07±20.33	90.66±25.93[NS]
HDL-cholesterol (mg/dl)	70.35±9.20	61.62±9.98[NS]
LDL-cholesterol (mg/dl)	26.01±0.115	19.52±6.26[NS]

[1)]Mean±SD
[2)]Not significantly different from control group at $p<0.05$.

scapular brown adipose tissue by increasing nonepinephrine secretion in rats (14).

We conclude that garlic vinegar consumed for only 4 weeks significantly decreased body weight. More trials should be undertaken to examine this effect in large numbers, for longer periods of supplementation, and in patients at increased risk for heart disease.

SUMMARY

We investigated the effects of garlic vinegar supplementation on body weight, and concentration of plasma glucose, triglyceride, total cholesterol, LDL-cholesterol, and HDL-cholesterol in rats. Rats were fed high-cholesterol diets with or without garlic vinegar supplementation for 28 days. Garlic vinegar was made by fermenting 20% fresh garlic juice. In our results, body weights of the garlic vinegar group were significantly lower than those of the control group. The concentrations of plasma glucose, total cholesterol, LDL-cholesterol and HDL-cholesterol were not significantly different between the two groups for a period of up to four weeks. However, the concentration of plasma triglyceride was slightly decreased by garlic vinegar supplementation. In the present study, it appears that, garlic vinegar, a natural product, if used as a spice in daily meals in the dosage studied, helps to maintain lower body weight and triglyceride levels in hyperlipidemic subjects.

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